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SOVIET SCIENTISTS STUDY "SILVER" WATER

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Although the antiseptic properties of silver were known before the time of the ancient Greek historian Herodotus, attempts at practical utilization of the bactericidal effect of metals really date back to the beginning of the present century. As recently as 1907 - 1908, the Russian scientist Serikov described the first experiments in the use of silver and copper to disinfect water.

It has been established that this effect of silver and copper results from the presence of these metals in solution in the ionic state. Ions and ionogenic compounds of silver in solution kill one-celled organisms (bacteria) while having no effect on multicelled organisms (including animals and man).

In 1928, Moiseyev, Uglov, Lazarev, Dmitriyev, and other Soviet scientists undertook to disinfect water with silver prepared by a special method and deposited on large surfaces (beads, powdered carbon, river sand, absorbent cotton, and other inert substances). Enlarging the surface accelerated the rate at which the metal went into solution.

The results achieved along this line by Professor Moiseyev were interesting. His silvered sand purified water from bacteria in 2-4 hours. A substantial drawback to this method, however, lay in the fact that the degree of enrichment of water, or dosage, could not be controlled. Moreover, this method was also imperfect in that the effectiveness of solution of the metal depended on a number of chance phenomena, such as the state of the metal's surface, its purity, and the content of salts and organic admixtures in natural waters.

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Another method for saturated water with silver is the use of already prepared reagents such as silver nitrate, silver chloride, or an ammoniacal solution of silver. In working out this method, Soviet scientists, Aleksandrov, Lazarev, Yermolayev, Plevako, and others, demonstrated that metallic silver surfaces become active only as a result of formation on them of silver oxides or salts which, going into solution, form silver ions possessing bactericidal properties. Professor Yermolayev achieved the greatest success using the ammoniacal silver preparation "ermaprene," which readily permeates cell plasma. Professor Yermolayev's preparation has been employed in medical practice.

The method of enriching water with salts of the metal is convenient in that it permits the preparation of a solution containing any dosage of silver. But prepared reagents, particularly the Yermolayev preparation, are easily decomposed under the action of light, and, on long standing, their bactericidal properties become greatly reduced.

The most effective method, without the above deficiencies, is the electrolytic enrichment of water with silver ions. It is based on the fact that, when a direct current is passed between silver electrodes under certain conditions, electrolytic solution of silver takes place. The process can be controlled by varying the current. Thus, an accurate silver dosage can be obtained from a milliammeter reading.

Our first experiments in the preparation of such a silver solution were conducted in 1930. The "silver water" obtained by electrolytic solution, when added to a number of liquid food products, inhibited their spoiling, kept disinfected water sterile for a long period of time, etc. It was proven that the character of the process of electrolytic solution of silver depends to a considerable degree on both the composition of the water and the conditions of electrolysis. Thus, different admixtures (chiefly chlorides, sulfates, etc.) which are present in water often make the electrodes insoluble by forming dense films on the surface of silver. However, an excess of chlorides in water results in the formation of side products (silver peroxides and hypochlorite) which also possess strong bactericidal properties.

Among other factors having a substantial effect on the solution of silver are current density, frequency of the change of polarity of the electrodes, the distance between the latter, and the solution temperature.

Experiments to determine the bactericidal capacity of electrolytically prepared "silver water," which we conducted in the Laboratory of Water Technology, Academy of Sciences Ukrainian SSR, with the assistance of Scientific Associates Lebedintseva, Vershova, Savina, and others, revealed that "silver water" possesses strong disinfecting properties. Thus water contaminated with a large quantity of dysentery, typhoid fever, staphylococcus, and streptococcus bacteria was rendered sterile 1-2 hours after introduction of up to 0.5 mg of silver per liter and remained sterile for many days. It is interesting to note that bacteria introduced into this water later perished rapidly. In declining order of effectiveness "silver water" acts on bacteria of dysentery, typhoid fever, streptococcus, staphylococcus, etc.

Numerous experiments proved that the best dosage for decontamination of drinking water is 0.1-0.2 mg of silver per liter, for production of sterile ice 0.2-0.4 mg per liter. Doses of silver for water to be used in factories for washing dishes range from 0.2 to 0.6 mg per liter.

No less interesting are the results of investigations of the decontamination and preservation of food products with electrolytically prepared "silver water." Thus, in brewing, the introduction of 0.025-0.05 mg of silver per liter completely destroys acetic acid bacteria. Now a method has been developed for treating the microflora of milk with electrolytically prepared silver. The duration of the pasteurization process is considerably reduced if the milk is simultaneously treated with silver. Moreover, the natural properties of milk are better preserved; for example, silver does not destroy the vitamin C present in milk.

The margarine industry has also employed silver. Margarine treated with water containing silver ions becomes much more stable in storage. There are also indications that the use of silver ions results in the acceleration of processes of aging of wines and improves their flavor and bouquet.

Positive data obtained as a result of the treatment of milk, milk products, and wines with silver were also verified by investigations in our laboratory.

Silver also has great value as a medicinal and prophylactic agent. Different silver preparations have long been employed in medicine. It has now been established that, when in direct contact with inflamed or festered areas, electrolytically prepared silver solutions exhibit a pronounced medicinal action on these areas.

Electrolytically prepared silver solutions are also extremely effective medicinal agents for gastrointestinal ailments and inflammations of the eye, nose, and throat. Patients with stomach and duodenal ulcers showed an improvement in condition only 8-15 days after the beginning of treatment, experiencing a gradual cessation of pain and vomiting; while after 1-2 months of regular use of "silver water" they felt noticeably better. During the Great Fatherland War "silver water" was widely used for treatment of different wounds.

The electrolytic preparation of "silver water" is carried out in with an apparatus known as an ionator. The first ionators of domestic origin were made at the Laboratory of Water Technology, Academy of Sciences Ukr SSR, in 1937. In Kiev continuous production of several types of this apparatus has now been set up. These include stationary ionators LK-22 and LK-23, the low capacity portable ionator LK-25 in three models, and traveling type ionators LK-26 and LK-27.

The basic components of these ionators are the electric dosing element and the silver electrodes. The dosing element consists of a transformer, rectifier, voltmeter, milliammeter, rheostat, and automatic process control equipment.

In stationary ionators the silver electrodes are placed in a reservoir through which the water flows, while in portable and traveling types they are immersed in a container filled with water. Silver dosage is controlled by milliammeter readings in conjunction with data from a special table which takes into account the effect of the salt content of water on the solubility of silver.

It can be confidently stated that electrolytically prepared "silver water" will be widely used in Soviet science and engineering.

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